

## We Claims

1. A method for producing water-insoluble polysaccharides, comprising the steps of:
  - 5 (a) preparing a hydroxyl-containing polysaccharide solution;
  - (b) adjusting a moderate pH range of polysaccharide containing hydroxyl groups solution;
  - (c) cross-linking the hydroxyl-containing polysaccharide solution with the poly-functional epoxy compound and producing different shapes of the water-insoluble polysaccharide by taking shape procedure.
- 10 2. The method of claim 1 wherein said process of cross-linking is performed prior to the taking shape procedure.
3. The method of claim 1 wherein said process of taking shape procedure is preformed prior to the cross-linking reaction.
- 15 4. The method of claim 1 wherein said hydroxyl-containing polysaccharide is chosen from the group consisting of hyaluronic acid, carboxymethyl cellulose, starch, alginate, chondroitin-4-sulfate, chondroitin-6-sulfate, xanthane gum, chitosan, pectin, agar, carrageenan and guar gum.
- 20 5. The method of claim 1 wherein said step (a) comprising an aqueous solution of hydroxyl-containing polysaccharide has a dry solids content of from 0.2 to 10% by weight.
6. The method of claim 1 wherein said step (b) is carried out at a pH of 2 to 11.
- 25 7. The method of claim 6 wherein said method the preferred pH for carrying out the reaction is one of 2.5 to 7.5 and 9 to 11.
8. The method of claim 1 wherein said poly-functional epoxy compound is chosen from the group consisting of 1,4-butanediol diglycidyl ether (BDDE), ethylene glycol diglycidyl ether (EGDGE), 1,6-hexanediol diglycidyl ether, polyethylene glycol diglycidyl ether, polypropylene glycol diglycidyl ether, polytetramethylene glycol diglycidyl ether, neopentyl glycol diglycidyl ether, polyglycerol polyglycidyl ether,
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diglycerol polyglycidyl ether, glycerol polyglycidyl ether, tri-methylolpropane polyglycidyl ether, pentaerythritol polyglycidyl ether and sorbitol polyglycidyl ether.

- 5 9. The method of claim 1 wherein the molar equivalent ratio of said polyfunctional epoxy compound to said hydroxyl-containing polysaccharide is in a range of between 0.1 and 8.0.
- 10 10. The method of claim 9 wherein the optimal molar equivalent ratio of said poly-functional epoxy compound to said hydroxyl-containing polysaccharide is 0.2 to 6.0.
- 10 11. The method of claim 1 wherein said step (c) the cross-linking reaction is carried out at 10°C to 60°C for 10 min to 12 hours.
12. The method of claim 1 wherein said step (c) the cross-linked polysaccharide solution is cast into a mold and allows to dry to yield a film of water-insoluble polysaccharide.
- 15 13. The method of claim 1 wherein said step (c) the cross-linked polysaccharide solution is cast into a mold and allows to freeze-dry to yield a porosity of water-insoluble polysaccharide.
- 20 14. The method of claim 1 wherein said step (c) the cross-linked polysaccharide is intermittent squeezed into the organic solvent of coagulant and allows yielding a sphere of water-insoluble polysaccharide.
- 25 15. The method of claim 12 to 14 wherein said the film, porosity and sphere of water-insoluble polysaccharides may be used as various medical and cosmetic uses after washing with water/organic solution, distilled water and drying under vacuum.
16. The method of claim 12 wherein the material of mold can be made up with the ceramic, metal or polymer.
17. The method of claim 12 wherein said the preferred temperature of drying is between 25°C to 70°C.
- 30 18. The method of claim 13 wherein said the porosity of water-insoluble polysaccharide is in the form of a pore morphology with the inter connective structure.

19. The method of claim 14 wherein said the cross-linked polysaccharide is precipitated from the mixed solution under stirring condition and allows to produce a powder or sheet of water-insoluble polysaccharide by filtration.

5 20. The method of claim 15 wherein said the cross-linked polysaccharide is continual pressed into the coagulant organic solvent by a squeezer apparatus, and allows to produce water-insoluble polysaccharide fiber of 50  $\mu$ m-1 mm thickness.

10 21. The method of claim 14 wherein said the diameter of sphere is between 50  $\mu$ m and 1 mm.

22. The method of claim 14 wherein said coagulant solution comprises water and organic solvent.

23. The method of claim 22 wherein the weight fraction of said organic solvent is between 60% and 100%.

15 24. The method of claim 22 wherein said organic solvent is chosen from the group consisting of 1,4-dioxane, chloroform, methylene chloride, N, N-dimethylformamide (DMF), N, N-dimethylacetamide (DMAc), ethyl acetate, acetone, methyl ethyl ketone (MEK), methanol, ethanol, propanol, isopropanol and butanol.

20 25. The method of claim 14 wherein said method is carried out at a temperature of 5°C to 60°C.

25 26. The method of claim 15 wherein said organic solvent is chosen from the group consisting of acetone, methyl ethyl ketone (MEK), methanol, ethanol, propanol, isopropanol, butanol and the mixture of each organic solvent.

27. The method of claim 15 wherein the weight fraction of said organic solvent is between 50% and 100%.

28. The method of claim 26 wherein the ketone and alcohol can be mixed with any ratio.

30 29. The method of claim 15 wherein said method the temperature of water/organic solution is between 15°C and 50°C.

30. The method of claim 15 wherein said method the preferable temperature

General		Performance		Reliability		Security		Compliance	
Category	Sub-category	Value	Unit	Value	Unit	Value	Unit	Value	Unit
System Overview	System Name	Project Phoenix		Version 1.0		Release Date 2023-10-27		Status: Active	
	Project Lead	John Doe		Contact: 555-123-4567		Email: john.doe@company.com		Role: Project Manager	
	Team Size	10	Members	Skill Set: Full Stack		Experience: 5+ Years		Availability: Full Time	
	Budget	\$50,000	USD	Actual Spend: \$45,000		Variance: +\$5,000		Forecast: \$50,000	
	Timeline	12 Weeks	Duration	Start Date: 2023-10-01		End Date: 2023-11-30		Milestone: UAT Complete	
Performance Metrics	Uptime	99.9%	Availability	Latency: 50ms		Throughput: 1000 req/s		Error Rate: 0.1%	
	Load	1000	Users	CPU Usage: 15%		Memory Usage: 20%		Disk I/O: 10MB/s	
	Response Time	200ms	API	Database: 100ms		Cache: 50ms		Queue: 10ms	
	Scalability	10x	Scale	Horizontal: Yes		Vertical: No		Elastic: Yes	
	Security Audit	Passed	Compliance	Vulnerabilities: 0		Patches: All Up to Date		Incidents: 0	
Reliability Data	MTBF	10000	Hours	MTTR: 1 Hour		RTO: 4 Hours		RPO: 1 Hour	
	Availability	99.9%	SLA	Uptime: 99.9%		Downtime: 0.1%		Incidents: 0	
	Incidents	0	Count	Severity: Low		Impact: Minimal		Resolution: 1 Hour	
	Disasters	0	Count	Recovery: 4 Hours		Data Loss: 0		Backup: Daily	
	Compliance	GDPR	Compliance	HIPAA		SOX		PCI DSS	
Security Audit	Vulnerabilities	0	Count	Patches: All Up to Date		Incidents: 0		Resolution: 1 Hour	
	Penetration Test	Passed	Result	Vulnerabilities: 0		Patches: All Up to Date		Incidents: 0	
	Security Audit	Passed	Result	Vulnerabilities: 0		Patches: All Up to Date		Incidents: 0	
	Incidents	0	Count	Severity: Low		Impact: Minimal		Resolution: 1 Hour	
	Disasters	0	Count	Recovery: 4 Hours		Data Loss: 0		Backup: Daily	
Compliance	GDPR	Compliance	HIPAA		SOX		PCI DSS		
	ISO 27001	Compliance	NIST 800-53		FISMA		CIS 15		
	PCI DSS	Compliance	SOC 2		ITIL 4		Lean Six Sigma		
	Lean Six Sigma	Compliance	ITIL 4		FISMA		CIS 15		
	ITIL 4	Compliance	FISMA		CIS 15		NIST 800-53		

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